

**REMARKS/ARGUMENTS**

**Claim Status**

Claims 1-15 and 17-26 remain in this application. Claims 10 and 23 have been amended. Claim 16 has been cancelled by a previous amendment. Claims 1-9 and 18-22 have been withdrawn as a result of an earlier restriction requirement. In view of the examiner's earlier restriction requirement, applicant retains the right to present claims 1-9 and 18-22 in a divisional application.

**Amendment to the Specification**

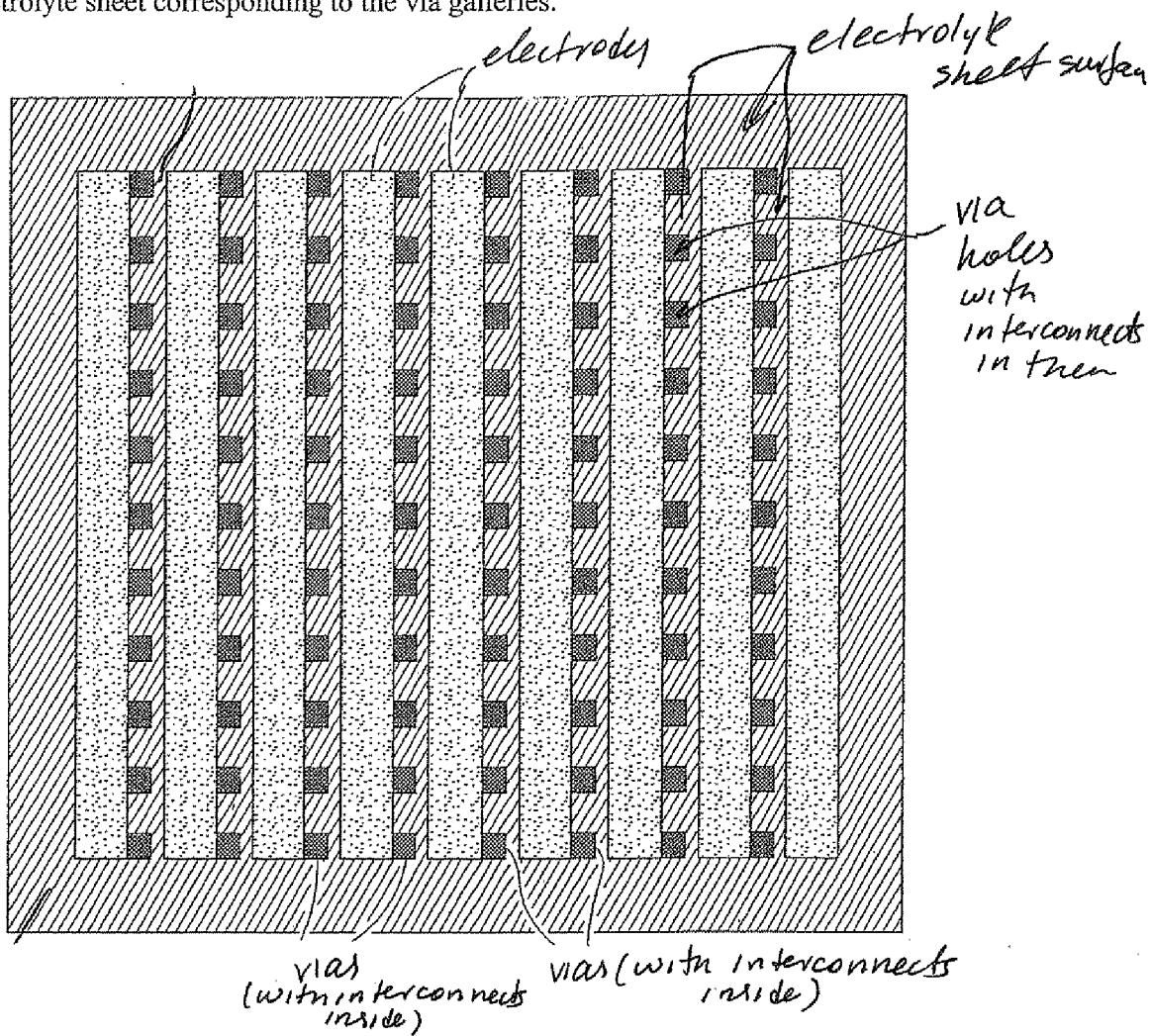
Paragraph [0039] of the Specification has been amended to better comport with paragraph [0038].

**Drawings**

Fig. 5B had been amended to correspond better to Fig. 5A and to the rest of the Applicants' Specification and now clearly shows that the electrolyte sheet does not contain holes between the electrodes, except for via holes 56.

More specifically, Fig. 5B illustrates a cross-section of the solid oxide electrode/electrolyte assembly. Fig. 5A illustrates the top view of this assembly. As shown in Fig. 5A, the electrolyte sheet is a solid sheet, except for a series of via holes 56 located in the via galleries. (The vias, or via holes) are provided for the interconnects 56'). As shown below, in the original figure 5A, the electrodes 52 are depicted by the rectangles shaded by dots and the side 20 of the electrolyte sheet 10 was depicted by the areas that were shaded by diagonal lines, with the electrolyte sheet portions corresponding to the via galleries situated between the electrodes. The small, darker squares corresponded to the vias (via holes) containing interconnects 56' situated in the via galleries. Thus, the original Fig. 5A, (and the present Fig. 5A) clearly shows that the electrolyte sheet material (see below, the areas shaded by diagonal lines) extends

around and between the electrodes, and that there are no holes except for vias in the electrolyte sheet corresponding to the via galleries.



Furthermore, this amendment to Fig. 5B is supported by Applicants' Specification, for example paragraphs [0039], [0066], and [0067].

#### § 112 Rejections

**Claims 10-15 and 23-26 are rejected under 35 USC 112, first paragraph, because the specification, while being enabling for the intermediate electrolyte layer..., does not reasonably provide enablement to a solid oxide/electrolyte assembly comprising the electrolyte with the above feature"**

The Examiner has rejected claims 10-15 and 23-26 under 35 U.S.C. § 112, first paragraph. In particular, the Examiner asserts that “the specification, while being enabling for an intermediate electrolyte layer ‘wherein the average thickness of the electrolyte sheet situated under said at least one cathode and said at least anode is smaller than the average thickness of the electrolyte sheet not situated under said at least one cathode and said at least anode’, does not reasonably provide enablement for a solid oxide electrode/electrolyte assembly comprising an electrolyte with the above feature....Applicant has not provided the existence of the working examples to illustrate a solid oxide fuel cell with the electrode features conforming to the claimed features.”

Applicants respectfully disagree for the following reasons:

Claims 10-15 and 25-26 are supported and enabled by the Applicants’ specification. For example, Paragraph [0067] of Applicant’s specification describes that via galleries are spaces between electrodes (also, for example, see **Illustration A**, below), which contain via holes. Paragraph [0067] is also reproduced bellow for Examiner’s convenience (with emphasis added).

**“Figure 11A** illustrates an electrolyte sheet with thickness variations for control of mechanical flexure. **Figure 11B** illustrates a cross-section of the portion of this electrolyte sheet. Thicker regions  $t_1$  of the electrolyte sheet will become the via galleries of the finished device and are separated by a distance of 10 mm. The thin regions  $t_2$  will be printed with the electrode layers. To achieve the desired device flexural properties, it is preferable that the thickness of the electrolyte sheet corresponding to via galleries be 15 micrometers to 60 micrometers and, preferably, 15 to 45 micrometers thick and even more preferably 18 to 25 micrometers thick. For example, the thicker regions may be 60 micrometers thick while the thinner regions may be 20 micrometers thick, which results in  $\Delta t$  of 40 micrometers.”

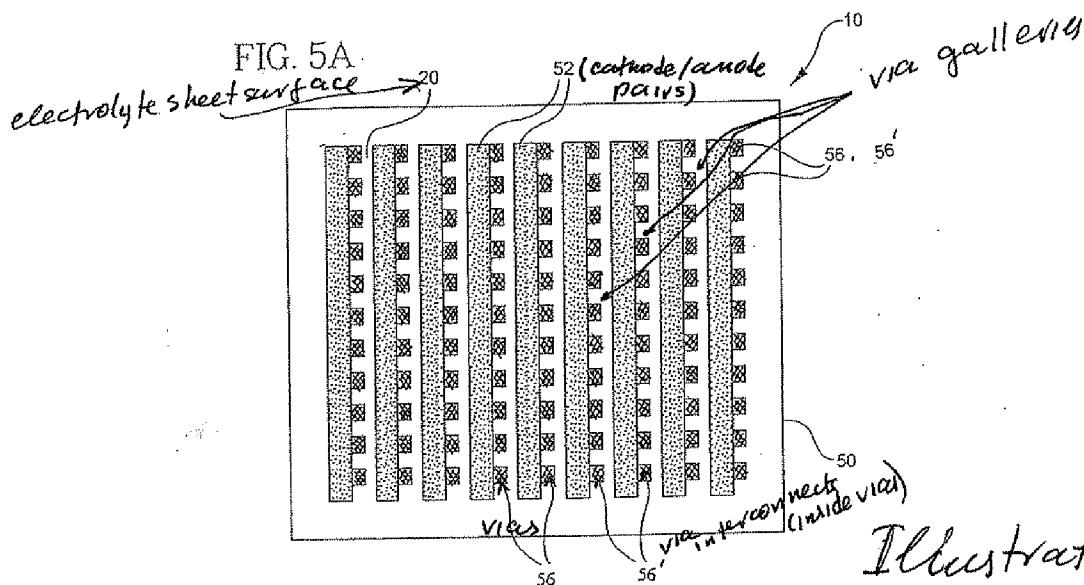


Illustration A

That is, via galleries are not the holes, but the areas or regions of the electrolyte sheet that are situated between electrodes and contain and surround the via holes (vias 56) containing interconnects. Paragraph [0066] (see Example 2) also specifies that it is desirable to provide more thickness to the electrolyte sheet in these regions-i.e., the via gallery regions. This paragraph is reproduced below (underlines added) for Examiner's convenience.

“Applicants also discovered that it is desirable to modulate the electrolyte thickness in a patterned fashion in order to improve its net mechanical properties. First consider the case of an electrolyte of uniform thickness. If the space between electrode strips (i.e., via galleries 55) has less printed material (to accommodate vias and/or via pads) the via gallery will be comparatively less “stiff” than the electrode regions. On flexure of the device, the via gallery regions will be subject to stress concentration because they are relatively more flexible than the electrode regions and will have a relatively short radius of curvature. In this case, because we wish to avoid concentrating stress in the

regions between the electrodes which contain the vias (i.e., through holes), a more uniform flexure is desired throughout the electrolyte sheet. Therefore, it will be advantageous to provide more thickness in the via gallery regions, which will provide more uniform flexure of the electrolyte sheet. “

Figures 11A and 11B, for example, illustrate an electrolyte sheet with such features. More specifically, paragraph [0067] describes that the regions with thickness  $t_1$  of the electrolyte sheet will become via galleries and that the thinner regions with the thickness  $t_2$  will be printed with the electrode layers. Also, for example, paragraph [0073] (Example 4) describes how to make an exemplary electrolyte sheets that have a different thickness area, and describes two more additional configurations of the electrolyte sheets. Also, for example, Figures 14A and 14B, illustrate the indented or thinner areas 30. Figure 14C corresponds to Figs 14A and 14B and shows thinner areas  $t_1$  of the electrolyte sheet (that correspond to via galleries) and thicker areas (areas with thickness  $t_2$  that will be printed with the electrode layers).

Independent Claim 23 has been amended to specify that the claim device has a plurality of cathodes and anodes. Claim 24 depends from claim 23 and thus also include this feature. Claim 10, and its dependent claims also include this feature. Figure 5A (see illustration A, above) illustrates a solid oxide electrode/electrolyte assembly comprising electrodes 52, as well as the via galleries situated therebetween, and the via holes (56) located inside the via galleries (55). Paragraphs [0066]and [0067] of the Applicant's Specification also describe the via galleries. Therefore, the amendment to Fig. 5 is not introducing any new matter and is supported by the original drawing(s) and specification.

**Claims 10-15 and 23-26 are rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

The Examiner stated: "Regarding claims 10 and 23, the limitation "not situated under said at least one cathode and at least anode" is indefinite because the subject matter is not clearly pointed out. Figures 11A and 11B show printing one electrode not both electrodes. Paragraph [0067] describes the thicker portion  $t_2$  being the "via gallery" which is disclosed earlier in the instant disclosure as a hole and so no electrolyte is present to be thicker than any other portion".

Applicants respectfully disagree with this assertion. Via gallery (55) is not a via hole (56) and has not been described as such. A via hole is a hole contained within the via gallery. A via gallery is an area or region between electrodes- i.e. the electrolyte sheet strip situated between electrode strips, which is provided to accommodate the via holes (vias) and via pads.

For example, paragraph [0039] of Applicant's specification teaches that "assembly 50 includes a plurality of cathode-anode pairs 52, 54. The cathode-anode pairs 52, 54 are separated from one another by via galleries 55. The via galleries 55 include a plurality of interconnects (called "via interconnects") 56' situated in the vias 56. These interconnects 56' conduct electronic current from the anode of one cell to the cathode of an adjacent cell. It is preferable that the body of the electrolyte sheet 10 which is located under the electrodes (anode(s) and cathode(s)) is relatively thin. That is, it is preferable that 50% and more preferably 75% of the area under the electrodes be thinned. This design is notable for the absence of expensive interconnect plates.""

Also, for example, as clearly described in paragraph [0066] of the Application, this area (via gallery) of the electrolyte sheet does not have the electrodes imprinted thereon, and thus, unless thickened (relative to the electrolyte sheet area under the electrodes), will be a subject to stress concentration during flexure of the electrolyte sheet. Thus, according to the Applicant's teachings, it is "advantageous to provide more thickness in the via gallery regions".

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Furthermore, with regard to Examiner's assertion that "Figures 11A and 11B show printing one electrode not both electrodes", it is well known to one of skill in the art that the fuel cells include two electrodes with the electrolyte being sandwiched therebetween. Such an assembly is shown, for example, in Figures 5A and 10 of the instant specification.

Thus, Claims 10-15 and 23-26 are not indefinite under 35 USC 112, second paragraph.

### **§ 103 Rejections**

**Claims 10-12, 15 and 23-26 rejected under 35 USC 103(a) as obvious over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara).**

The Examiner stated that Figures 2 and 8 of the Sasahara reference illustrate textured electrolyte sheet that have thicker areas around perimeter (thicker sealing portions).

The Examiner stated that these "thicker sealing portions allow the separator plate to be thinner, thereby decreasing the overall thickness of the fuel cell."

Applicants' claim 10 and now specifies that the thicker portions of the electrolyte correspond to the via galleries. This feature is not disclosed by either of the two cited references. Claims 11-12, 15 and 25-26 depend from claim 10 as their base claim. Therefore, because the two cited references, in combination, do not disclose all of the claim elements of claims 10-12, 15 and 25-26, these claims are not obvious over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara).

Claim 23 has been amended to specify that the solid oxide electrode/electrolyte assembly has a plurality of cathodes and a plurality of anodes situated on the electrolyte sheet and that the assembly does not include interconnect (separator) plates (see, for example, paragraph [0039] of the Applicant's specification for support). These features are not described in the two cited references (Finn or Sasahara). Claims 24 depends from claim 23 as its base claim, and thus incorporates all of the features of claim 23. Therefore, because the two cited references, in combination, do not disclose all of the claim

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elements of claims 23-24, these claims are not obvious over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara).

**Claims 10-15 and 23-26 are rejected under 35 USC 103(a) as being unpatentable over US Patent Publication 2001/0044043 (Badding) in view of US Patent Publication 2003/0180602 (Finn) and US 2002/0012825 (Sasahara).**

As described above, Applicants' claim 10-15 and 25-26 now specify that the thicker portions of the electrolyte correspond to the via galleries. This feature is not disclosed by either of the two cited references. Therefore, because the two cited references, in combination, do not disclose all of the claim elements of claims **10-15 and 23-26**, these claims are not obvious over US Patent Publication 2001/0044043 (Badding) in view of US Patent Publication 2003/0180602 (Finn) and US 2002/0012825 (Sasahara).

Both the Finn and the Badding references are silent with regard to the average thickness of the electrolyte sheet under the electrode being smaller than the portion not under the electrodes. Fig. 3B of the Sasahara reference illustrates utilises a thinner portion under of the electrolyte sheet being located under electrode, to provide flow channels for reactant(s), which results in thinner the separator plates (interconnect plates). This is shown, for example, Figs 1 and 2 of the Sasahara reference. Applicant' claim 23 specifies that the claimed assembly has no inter connect plates (i.e., no separator plates). The Badding reference also does not disclose such plates. Accordingly, there is no motivation to modify the Badding reference with the features of Finn Sasahara, as suggested by the Examiner. Therefore, claims **23-24** are not obvious over US Patent Publication 2001/0044043 (Badding) in view of US Patent Publication 2003/0180602 (Finn) and US 2002/0012825 (Sasahara).

**Claims 13 and 14 are rejected under 35 USC 103(a) as being unpatentable over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara).**

Claims 13 and 14 depend from claim 10 as their base claim, and thus expressly include the language of the amended claim 10. Accordingly, claims 13 and 14 are not unpatentable over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara), because these references, in combination, do not disclose all of the claim elements of claims 13 and 14.

Furthermore, neither the Finn nor the Sasahara reference disclose “average electrolyte sheet thickness is between 4 and 15 micrometers” (see claim 13), nor “the average electrolyte sheet thickness is between 8 and 15 micrometers” (see claim 14). The Examiner pointed out that Finn discloses an average thickness of 20 microns and stated that “Claims that differ from the prior art only by slightly different (non-overlapping) ranges are *prima facie* obvious without showing that the claimed range achieves unexpected results relative to prior art”. Applicants respectfully disagree that the ranges claimed in claims 13 ad 14 are only slightly different from the range disclosed by the Finn reference.

Applicants Claims 13 and 14 call for a maximum thickness of 15  $\mu\text{m}$ , which is a lot (25%) smaller than the minimum thickness described in paragraph [0195] of the Finn reference, and more than 3 times smaller than the preferred minimum thickness of 50  $\mu\text{m}$ . This is not an “only slightly different” range.

It is not obvious that making the electrolytes sheets within the claimed thickness range and with the specific claimed thickness variations will not jeopardize electrolyte’s integrity and strength. It is Applicants who realized that by making the electrolytes sheets within the claimed thickness range and with the specific claimed thickness variations, the electrolyte sheet will maintain its structural integrity, while the ohmic resistance will be improved beyond 0.5 ohms/cm<sup>2</sup>. As mentioned in the previous respons, flexibility and strength of the electrolyte sheet is not an inherent characteristic of the electrolyte sheet, because these properties of the electrolyte sheet depend on: (i) overall or regional flatness of the electrolyte sheet, (ii) electrolyte sheet microstructure, and (iii) size and frequency of inclusions or defects. **Furthermore, as described**

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**above, the Finn reference discloses an electrolyte sheet made of a different material than the one claimed by the Applicants.**

**Claims 10-15 and 23-26 rejected under 35 USC 103(a) as obvious over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara) and US 2001/0044041 (Badding).**

As described above, Applicants' claim 10-15 and 25-26 now specify that the thicker portions of the electrolyte correspond to the via galleries. This feature is not disclosed by either of the three cited references. Therefore, because cited references, in combination, do not disclose all of the claim elements of claims 10-15 and 25-26, these claims are not obvious over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara) and US 2001/0044041 (Badding).

With regard to claims 23 and 24, these claims specify that the claimed device has no interconnect (separator) plates. The Finn reference discloses such plates. Thus, modifying the Finn reference by replacing the Finn electrolyte sheet with the partially stabilised sheet of Badding would still yield a different design than the one claimed by the Applicants. Furthermore, since Applicants' design lacks these plates, there is no need to thin them. Accordingly, there is no motivation to combine these references.

Therefore, Claims 10-15 and 23-26 are not obvious over US Patent Publication 2003/0180602 (Finn) in view of US 2002/0012825 (Sasahara) and US 2001/0044041 (Badding).

### **Conclusions**

Based upon the above amendments, remarks, and papers of records, applicant believes the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

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Applicant believes that no extension of time is necessary to make this Reply timely.

Should applicant be in error, applicant respectfully requests that the Office grant such time extension pursuant to 37 C.F.R. § 1.136(a) as necessary to make this Reply timely, and hereby authorizes the Office to charge any necessary fee or surcharge with respect to said time extension to the deposit account of the undersigned firm of attorneys,

Deposit Account 03-3325.

Please direct any questions or comments to Svetlana Z. Short at 607-974-0412.

Respectfully Submitted,

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